Everett; and delete the word "Thus" in the sentence which, at present, (wrongly) follows instead of preceding it. This change is obviously called for by the context:—for the reader has just been told how far *theory* had guided Thomson as to certain "absorptions," &c., of heat; and, of course, expects next to be told what additional information, as to these "absorptions," &c., Thomson obtained by *experiment*.

Still, confused as it is, the passage could not (except possibly from the point of view of history) embarrass a reader of § 196; for the nature of the Thomson effect is there *again* clearly stated, and even illustrated by a diagram. [A much more serious case of confusion is to be found at p. 366, line 15; where (by the omission of a few words) my copyist has made absolute nonsense of a quotation from Clerk-Maxwell.]

The statement quoted by Dr. Everett obviously requires to be restricted, as follows:—

An electric current, passing from cold to hot in copper, behaves as a real fluid would do:—i.e. *it tends to reduce the gradient of temperature. In iron, under the same circumstances, it tends to increase the gradient.*

It is clear that this statement has nothing to do with the *general* nature of the Thomson effect:—*i.e.* "absorption" or "disengagement" of heat:—for *this* would depend upon the temperature of the fluid spoken of. It raises the question of the excess of Thomson effect in one locality, over that in another, at a lower mean temperature but with an equal gradient.

Dr. Everett seems to forget that, though the water-equivalent of a metal may be treated as sensibly constant through moderate ranges of temperature, the "specific heat of electricity" cannot so be treated. Using his notation, (with the proviso that θ is *absolute* temperature) we have $\sigma = k\theta$, and the equation he quotes from Thomson is

$$\frac{d\theta}{dt} = -\frac{k\theta}{c}\frac{d\theta}{dx}.$$

Happily, this can be integrated, so that we have

$$\theta = F\left(x - \frac{k}{c}t\theta\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Now suppose the gradient of temperature to be uniform and positive along x positive (the direction of the unit current); when $t = 0$ we have

$$\theta = ex.$$

Generally, therefore,

$$\theta = e\left(x - \frac{k}{c}t\theta\right),$$

$$= \frac{ex}{1 + \frac{k}{c}et}.$$

Thus the gradient becomes less steep:—*i.e.* there is a tendency to reduce temperature differences, when k is positive, as in copper. In iron, where k is negative, the tendency is to make the gradient steeper:—*i.e.* to exaggerate differences of temperature. Of course, as in all these thermo-electric matters, reversal of sign of the gradient reverses the thermal effect.

The general integral (1) denotes a process of continued *simple shearing*, not *translation*, of the "temperature curve." Were it not for heat-conduction, harmonic waves of temperature would tend to become *breakers*. But it is idle to speculate farther.

How much of this is Thomson's I don't certainly know; and I am for the present too busy to enquire. But it would be difficult to overestimate his services to Thermo-electricity.

This will, I hope, meet with Dr. Everett's approval. As to his letter, I would say (in Scottish legal phrase) "*Quoad ultrà*, denied." P. G. TAIT

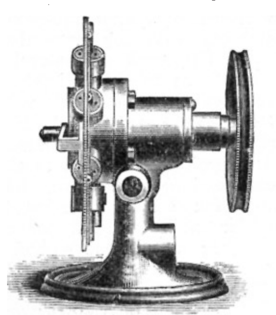
May 28

Power in Laboratories

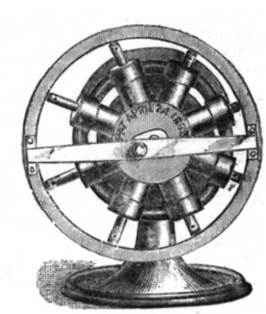
IN connection with the admirable devices for the distribution of driving-power in laboratories, illustrated in NATURE, vol. xxxiii. p. 248, the description of a novel and very effective form of water-engine, with which I have been experimenting for several months, will be of interest.

One of these motors is set up in the cellar of our science hall, where it is supplied with aqueduct-pressure of sixty pounds to the square inch, and the power is transmitted from it by means of rubber belting led over "idle pulleys" to the upper stories of the building, where a small engine-lathe and dynamo are driven. A word will suffice to explain the very simple construction of the motor—a system of radial cylinders, with their bases at the centre of the motor, through which runs the driving-shaft. The pistons in these cylinders are single-acting, and the water is admitted to them in succession by the rotary valve which forms part of the main shaft. The pistons, thus, in pressing outward, exert their force against a strong ring, to which is bolted a cross-bar which engages the crank of the main shaft. Thus the ring, in turning the shaft, has the vibratory motion of an eccentric, and returns the opposite pistons to the bases of the cylinders, at the same time exhausting the water through the interior of the rotary valve. Three pistons are thus constantly exerting a thrust upon the ring, whatever its position, and this thrust being always tangential to the arc of revolution of the crank, there is no "dead centre," and the uniform pressure at right angles to the crank at every part of its arc insures an even rotary motion and obviates the necessity of a balance-wheel. The ends of the piston-rods are slotted, and contain anti-friction rollers which bear against the ring, and this latter is grooved all round, so that, in addition to its simple and rapid motion as an eccentric, the ring is free to perform a slow motion of revolution independently of its work of driving the crank, and the wear of the interior face of the ring is thus equalised and becomes inappreciable.

The supply-pipe for this motor has a diameter of $1\frac{1}{2}$ inches, and it gives an equivalent of nearly 2 horse-power. The flow of water is regulated by means of a balanced valve, under control from every point where the power is used. As the use of the power is, for the most part, discontinuous, like that in lathe-work, I find it better to start and stop the motor as often as desired than to use the ordinary device of shifting a belt off and on a loose pulley. All possible economy of water is assured, as



Side View.



Front View.

none of it runs to waste without giving its equivalent of power at just the time when it is required. It will be seen that this form of motor is specially adapted to such uses, as there is no fly-wheel whose inertia has to be overcome; and as the motor has no "dead centre," it readily starts from any position, overcoming a maximum resistance.

Where continuous running is required, at an invariable speed, a centrifugal governor is attached to the belt-wheel, and acts upon the amplitude of vibration of the ring, diminishing the stroke of the pistons when the resistance is removed. The governor thus gauges the water-supply exactly proportional to the resistance to be overcome, and makes the motor a very effective driving-power for dynamos and all sorts of machines and apparatus in which a uniform speed is necessary, while the resistance is variable.

The difficulties barring the economic use of water as a motive-power, owing to its weight and incompressibility, seem to have been successfully overcome in this form of motor, with which unexampled speeds have been attained, and more than 80 per cent. of the theoretical power of the water derived. The little cut annexed shows the smallest size of these motors—it stands about 10 inches high, and uses a $\frac{1}{2}$-inch supply, consuming less than six quarts of water in 100 revolutions. I frequently run it at a speed of 1000 revolutions to the minute, and at the manufactory I have seen the same motor attain double this velocity. The motor runs equally well with compressed air (or with steam, if the piston-packings are changed), and with either of these media even higher speeds are attainable.

I find that the constant readiness of the motor for the immediate development of power, the little care it has required (only occasional oiling), and its economical consumption of water, are

very great advantages in its favour; and, for all laboratories supplied with aqueduct-pressure, I venture to think that it affords the best solution of the problem of inexpensive, convenient, and effective power. DAVID P. TODD

Lawrence Observatory, Amherst, Mass., May 15

Scientific Nomenclature

IN a letter published in NATURE for May 27 (p. 76) Prof. Minchin proposes to replace the expression "potential energy" by "static energy." It seems to have escaped his notice that a similar expression, proposed many years ago by Sir William Thomson, was used until it was replaced by the very words which Prof. Minchin wishes now to abolish. A short account of the question is given by Maxwell in "Matter and Motion," p. 81, and I should like to bring the following passage to the notice of those who take an interest in this question:—

"This is called the 'sum of the tensions' by Helmholtz in his celebrated memoir on the 'Conservation of Energy.' Thomson called it statical energy; it has also been called energy of position; but Rankine introduced the term potential energy—a very felicitous expression, since it not only signifies the energy which the system has not in actual possession but only has the power to acquire, but it also indicates its connection with what has been called (on other grounds) the potential function."

Harrow, June 8 G. GRIFFITH

Neæra

I WISH to request any of your readers who may dredge, or have opportunity this summer, to observe living or fresh specimens of the genus *Neæra*, Gray, and see whether branchiæ exist in that group. A Lamellibranch without branchiæ is anomalous, to say the least. I find in a new species of *Neæra* (sub-genus *Myonera*) from the Gulf of Mexico the following anatomical facts:—The mantle closed except for the small siphon and a narrow short slit for the thorn-shaped foot; no gills, no palps; the oral opening circular, plain; the roof of the peripedal cavity between the base of the body and the mantle margin is flattish, fleshy, with sparse pustules; a peripheral very stout pink muscle runs on each side around this, and is prolonged upward to the shell before the true adductor at each end of each valve, thus accounting for the double scars to be found there; the foot is close to the oral orifice, not grooved for the byssus, but pedunculated and surrounded by a groove; around the siphonal opening are numerous tentacular processes and a moderate number of ocelli. The specimens appear to be adult and perfectly preserved. An examination of specimens of *Neæra arctica* and *Neæra obesa*, Lovèn, indicated a similar state of affairs, though these specimens were not in as good condition as the one from the Gulf of Mexico. I do not find in the literature any categorical statement of the observation of gills in this genus. Clark is non-committal (in his "British Testacea"), Jeffreys speaks of seeing the "pink gills" through the shell, but that which he saw *pink* was without doubt the circular muscle I have mentioned.

The question is worthy of a definite solution. My specimens seem to leave no doubt that there are no gills, but it is always best to be suspicious of material long in alcohol.

WM. H. DALL

Smithsonian Institution, Washington, D.C., May 27

"Plants and their Defences"

WITH regard to the interesting article in your issue for May 6 (p. 5) on "Plants and their Defences," I should like to offer two remarks, and in return would be very glad to receive from you information upon a certain point. (1) The author enumerates different species of plants protected by the severe stings of ants, but does not seem to know the remarkable work of Beccari, "Piante ospitatrici ossia piante formicarie della Malesia e della Papuasia" (Malesia, vol. ii., Firenze, 1885). Beccari describes seventeen partly new species of "Myrmecophilous" Rubiaceæ, among which are eleven of Hyd*n*ophytum (not Hyd*ri*ophytum, as is erroneously given in the article in NATURE). You will find a further contribution to this question in Henry O. Forbes's "Wanderungen durch den Malayischen Archipel," vol. i. pp. 84–88 of the German translation.

For my part, I should be greatly obliged if you would communicate to me the title of the original work from which the author of "Plants and their Defences" has taken his account of *Triplaris Schomburgkiana*, *Schomburgkia tibicinis*, and *Acacia sphærocephala*.

(2) Concerning the same article, Mr. Alfred W. Bennett (NATURE of May 20, p. 52) is inclined to think that the poisonous fluid of the nettle-glands is not formic acid, as generally conjectured, because the fluid frequently has an alkaline reaction. As a matter of fact, Prof. Dr. Haberlandt, at Graz (Austria), has recently, in vol. xciii. of *Sitzungsberichte des kaisersl. Akademie der Wissenschaften in Wien*, 1886, Februar-Heft, shown in his article, "Zur Anatomie und Physiologie der pflanzlichen Brennhaare," that (1) the poison of the stinging glands is not identical with formic acid; (2) nor is it the albumen dissolved in the fluid of the glands; but (3) that most probably this fluid is a transformed ferment or enzymotic poison.

Frankfurt a. Oder, June 2 E. HUTH

A Remarkable Hailstorm

ON April 17, at 4 o'clock p.m. (local time), a very remarkable hailstorm visited the neighbourhood of a small hamlet, called *El Totumo*,[1] not far from the town of Tinaco, section Cojedes, State of Zamora, Venezuela. The place is approximately in 9° 25′ N. lat., and 68° 5′ long. W. of Greenwich, certainly not more than 200 metres above sea-level. My informant is a resident of El Totumo, named Nicolas Moreno Nuñez, who is universally said to be a trustworthy and respectable man. There was first a very heavy thunderstorm with much rain; but after some time hailstones began to fall in such abundance that it might have been easy to collect them by hundreds of bushels, some weighing as much as two ounces. It is well known that between the tropics hailstorms are exceedingly rare in localities situated in the lowlands; but the present case is still more interesting, on account of the colour of the hailstones, some of which were *whitish, whilst others were blue or rose-coloured.* I have read of but one instance in which the two last-mentioned colours were observed, viz. in the hailstorm of Minsk of June 14, 1880, described by Lagunowitch, and quoted by Th. Schwedoff in his memoir "On the Origin of Hailstorms."[2] Schwedoff thinks that the blue and rosy colours are owing to the presence of salts of cobalt and nickel, and thus confirm his hypothesis of the cosmic origin of hail. I do not know whether the existence of those mineral constituents in the hailstones of Minsk was ever made certain by chemical analysis, and it is of course impossible for me to do so in the present case, when almost a month has passed since the phenomenon took place. But it is undoubtedly a very curious coincidence that the *same* colours should have been observed in both instances and in localities so widely separated from each other; whilst there is not the slightest possibility that my informant, an honest and plain countryman of no literary education whatever, should have had any knowledge of such an observation having been made before.

Caracas University, May 12 A. ERNST

VISITATION OF THE ROYAL OBSERVATORY

THE visitation to the Royal Observatory by the Board of Visitors took place last Saturday, when there was a very numerous attendance. The report of the Astronomer-Royal to the Board gives, as usual, an account of the work done during the past year, and references to any points of interest or importance which have been raised. From the report we select the following particulars:—

Mr. Turner has recently investigated the discordance between observations for coincidence of the collimators made respectively through the apertures in the cube of the transit-circle and with the instrument raised. A wooden model of the cube was constructed through which the observation could be made when the transit-circle was raised, and it was thus shown that the discordance was due to the cutting off of portions of the object-glasses by the cube, and not to any effect of temperature. In view of this result it seems desirable that the optical

[1] This is the vernacular name of the calabash-tree (*Crescentia Cujete*); there is, or was, probably a remarkable specimen of this tree in the neighbourhood of the hamlet.

[2] I only know a Spanish translation of Schwedoff's memoir, in *Crónica científica* (Barcelona), 1882, No. 120, pp. 553-60.